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1971 ANIMAL INVESTIGATION PROGRAM
ANNUAL REPORT

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by
Donald D. Smith and Kenneth R. Giles
National Environmental Research Center-Las Vegas

U.S. Environmental Protection Agency
Las Vegas, NV 89114

Published July 1975

This research performed under a Memorandum
of Understanding No. AT(26-1)-539
for the
U.S. ATOMIC ENERGY COMMISSION

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Effective June 29, 1975, the National Environmental Research Center-Las Vegas (NERC-LV) was designated the Environmental Monitoring and Support Laboratory-Las Vegas (EMSL-LV). This Laboratory is one of three Environmental Monitoring and Support Laboratories of the Office of Monitoring and Technical Support in the U.S. Environmental Protection Agency's Office of Research and Development.

ABSTRACT

This report presents the data obtained from the radioanalysis of tissues collected from cattle, deer, desert bighorn sheep, and other wildlife that reside on or near the Nevada Test Site.

Cesium-137 and ^{106}Ru were the only gamma-emitting radionuclides detected in the soft tissues of range cattle. Ruthenium-106 was detected only in the lungs of animals sampled in May.

Strontium-90 levels in the cattle femurs ranged from 2 to 37 pCi/g of ash. The latter value was found in the bones of a 14-year-old cow that had lived on the Nevada Test Site her entire life. The bones of the same animal also had the highest level of ^{239}Pu (46 pCi/g of ash) that was reported. Analysis of her 8-month-old fetus revealed the presence of detectable levels of ^{239}Pu which indicates placental transfer of this radionuclide. The average ^{90}Sr levels in the bones from deer and desert bighorn sheep were 3.2 and 4.7 pCi/g of ash, respectively.

Elevated levels of ^{106}Ru and ^{3}H were found in the tissues of two mule deer collected near the drainage ponds that collect runoff waters from mines used for nuclear testing activities.

Other animals sampled included Golden eagles, feral horses, coyotes, and chukar. The ^{137}Cs levels in an eagle collected during 1964 varied only slightly from one collected during 1971.

No gross or microscopic lesions were detected that could be attributable to the effects of ionizing radiation.

Other activities of the Animal Investigation Program, including special studies, investigations, and public information displays, are described.

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INTRODUCTION

The history and evolution of the Animal Investigation Program of the NERC-LV, EPA, from its origin in 1957 have been described in previous reports.[1,2,3] The basic objectives of the Animal Investigation Program during 1971 were:

1. the determination of tissue concentrations of fresh and/or aged fission and activation products in biological samples obtained from cattle grazing on the Nevada Test Site and from those grazing off-site areas, when indicated,
2. the development and conduction of wildlife studies on and near the Nevada Test Site in cooperation with state and federal wildlife agencies in order to assess the radionuclide burden in tissues collected from various edible wildlife species,
3. the gross and microscopic examination of tissues collected from these domestic and wild animals for the detection of pathological changes, possibly due to the tissue concentrations of the radionuclides,
4. the maintenance of veterinary relations with the off-site population, and
5. the investigation of alleged damage to domestic animals resulting from the activities of the Nevada Operations Office of the Atomic Energy Commission.

The progress in achieving these objectives and summaries of the data collected during 1971 are presented in this report.

SAMPLE COLLECTION PROCEDURES AND METHODS

Nevada Test Site animals sampled during 1971 included beef cattle, dairy cattle, mule deer, feral horses, chukar, coyotes, and Golden eagles. Desert bighorn sheep from areas adjacent to the Nevada Test Site were also sampled. Figure 1 shows the location of the EPA's Experimental Farm and grazing areas on the Nevada Test Site.

After death each animal was necropsied and gross pathological conditions noted. If advanced post mortem changes had not occurred, the adrenals, eyes, heart, kidneys, liver, lungs, muscle, spleen, thyroid, and gonads were sampled and prepared for histopathological evaluation. Tissues collected for radioanalysis included rumen or stomach contents, liver, lung, muscle, thyroid, blood or urine, kidney, fetus (if present), and bone. Rumen contents from mule deer were collected for botanical analysis.

Thirteen animals from the Nevada Test Site beef herd were sampled during the year. Twelve of these were sacrificed and one died of natural causes. Also sampled were three dairy cattle from the Area 15 farm, two of which died from natural causes. The vital statistics of all Nevada Test Site cattle sampled during 1971 are presented in Table 1. Unless otherwise noted, each beef animal spent its entire life grazing on the Area 18 range of the Nevada Test Site (see Figure 1). The management of the beef herd and soil and range surveys of the grazing area have been published previously.[4,5,6]

Tissue samples were collected from four Nevada Test Site mule deer during 1971. (See Table 2 for vital statistics.) Two of the deer were collected by hunting and two were collected after being struck by motor vehicles.

Through the cooperation of state and federal wildlife officials, bone and/or tissue samples were collected from desert bighorn sheep (Ovis canadensis nelsoni). Most of the animals sampled were collected during the hunt held each winter in the mountains of the Desert National Wildlife Range which lies immediately southeast of the Nevada Test Site. Seven mature animals were collected during the 1970 hunt and 12 during the 1971 hunt. Three

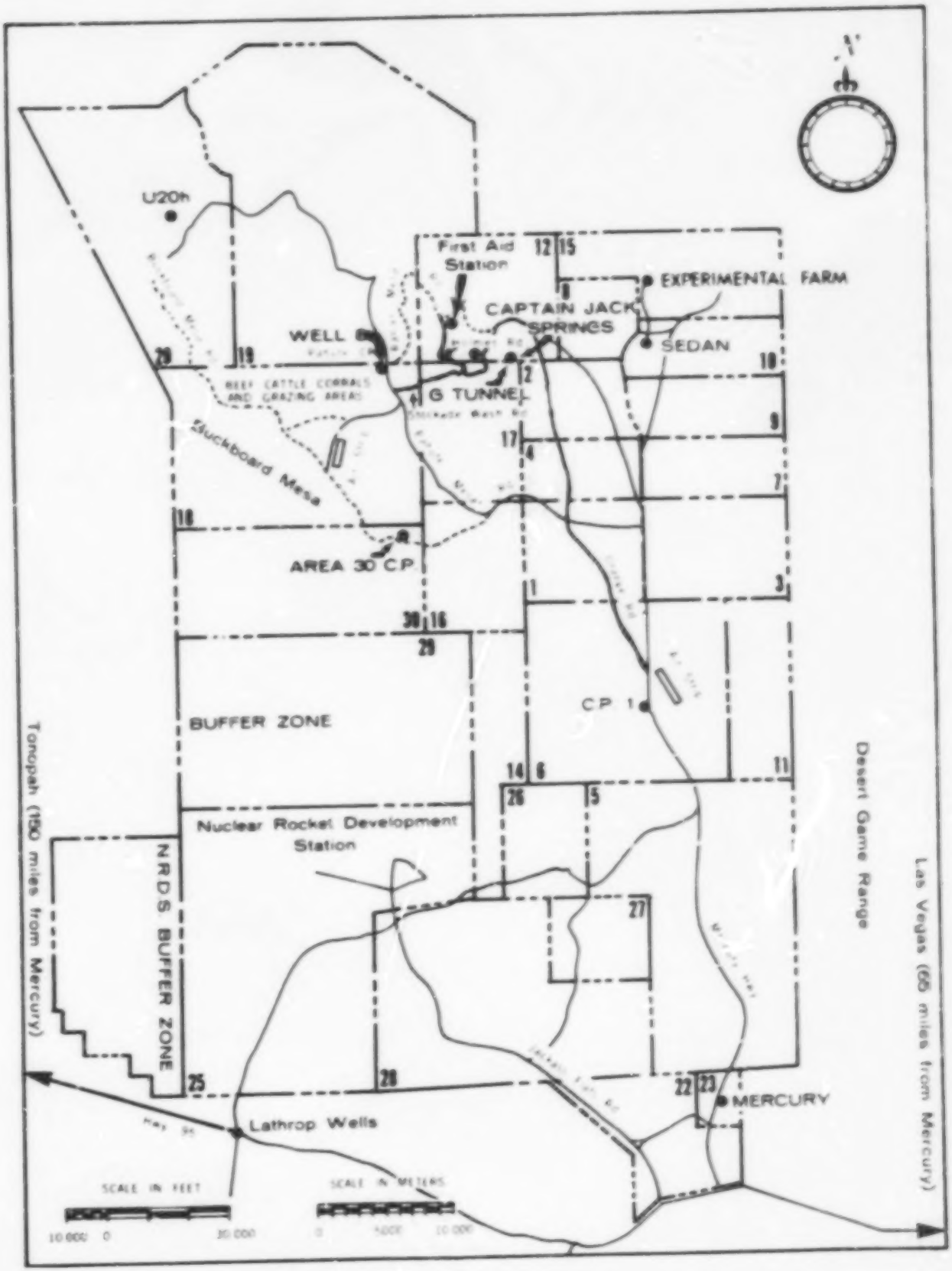

Figure 1. Location of EPA Facilities on the Nevada Test Site

Table 1. Vital Statistics of Nevada Test Site Cattle Sampled During 1971

Animal No.	Date Sampled	Breed	Sex	Age(yr)	Wt (kg)	Remarks
AHU-11	5/19	Holstein	F	11	500	Sacrificed to cull from herd as in poor condition and extremely lame. Maintained in dairy corrals, Area 15 farm.
2-NTS	5/20	Hereford	F	5	416	Sacrificed. Pregnant with eight-month fetus.
3-NTS	5/20	Hereford	M	2	352	Sacrificed.
4-NTS	5/20	Hereford	M	3	450	Sacrificed.
5-NTS	5/20	Hereford	F	14	500	Sacrificed. One of original herd. Pregnant with eight-month fetus.
6-NTS	5/20	Hereford	M	1	260	Sacrificed.
7-NTS	6/16	Hereford	F	6	280	Died from advanced squamous cell carcinoma of eye. Extremely poor condition.
8-NTS	6/16	Hereford	M	0.25	25	Sacrificed as calf of 7-NTS. In poor condition.
AHU-132	7/[illegible]	Holstein	F	3	425	Died from traumatic gastritis following a lingering illness. Maintained in dairy corrals, Area 15 farm.
AHU-48	8/24	Holstein	F	9	727	Died from gangrenous mastitis. Maintained in dairy corrals, Area 15 farm.
9-NTS	10/7	Hereford	M	3	514	Sacrificed.
10-NTS	10/7	Hereford	M	3	448	Sacrificed.

Table 1. Vital Statistics of Nevada Test Site Cattle Sampled During 1971 (Continued)

Animal No.	Date Sampled	Breed	Sex	Age(yr)	Wt (kg)	Remarks
11-NTS	10/7	Hereford	F	12+	337	Sacrificed. One of the original cows in herd. Ranged Area 18 last seven years. Pregnant with two-month fetus.
12-NTS	10/7	Hereford	F	3	270	Sacrificed. Pregnant with one and one-half-month fetus.
13-NTS	10/7	Hereford	F	0.5	160	Sacrificed.
14-NTS	10/7	Hereford	F	0.5	120	Sacrificed.

Table 2. Vital Statistics of Nevada Test Site Deer Sampled During 1971

Animal No.	Sex	Estimated Age(yr)	Estimated Wt. (kg)	Date Collection	Remarks
1	M	1.5	70	April 6	Collected in Area 12, 1-1/2 miles northwest of First Aid Station on Rainier Mesa.
2	F	4.0	65	July 13	Road kill, Area 12, one mile east of Stockade Wash Road and Pahute Mesa Road.
3	M	5.0	85	August 16	Road kill, Area 20, on Pahute Mesa Road near U-20-h.
4	M	1.5	70	November 10	Collected in Area 18 between Well 8 and Pahute CP.

animals that died from natural causes were also sampled during 1971. The vital statistics of these sheep are presented in Table 3.

An estimated 15 - 30 feral horses range the mountain areas of Areas 12, 2, 17, 16, and 30 of the Nevada Test Site.[7] The herd is not routinely sampled, but samples were collected from two animals that died of natural causes during 1971.

Three Golden eagles were sampled during 1971. Two of these were accident victims, (electrocution and motor vehicle collision), and the third died of unknown causes during 1964. Officials of the Desert National Wildlife Range preserved the latter eagle by freezing until it was submitted for analysis.

Two coyotes and one chukar were sampled during 1971.

Table 3. Vital Statistics of Desert Bighorn Sheep Sampled During 1970-1971

Animal No.	Sex	Estimated Age(yr)	Estimated Wt (kg)	Date Collected	Samples Collected	Remarks
4-70	M	7	75	11/22/70	Hock Lung	Hunter kill in Yellow Jacket Canyon, Umit 27-B-1, Desert National Wildlife Range.
5-70	M	4	68	11/28/70	Hock Lung	Hunter kill two miles northwest of White Rock Spring, Desert National Wildlife Range.
6-70	M	8	80	11/25/70	Hock Lung	Hunter kill at Warm Springs on Desert National Wildlife Range.
7-70	M	8	85	11/25/70	Lung	Hunter kill four miles southeast of Keyhole.
8-70	M	6	90	11/25/70	Hock Lung	Hunter kill at Lamb Spring, Desert National Wildlife Range.
9-70	M	4	90	11/25/70	Hock Lung	Hunter kill at White Rock Spring, Desert National Wildlife Range.
10-70	M	Unk	Unk	12/24/70	Hock Lung	Hunter kill, Indian Canyon Reservior, Unit 27-A-2, Desert National Wildlife Range.
1-71	F	2 mos	15	02/05/71	Hock Muscle Thyroid	Captive lamb, Corn Creek, Desert National Wildlife Range. Died of pneumonia.
2-71	M	1 mos	10	06/12/71	Hock Liver Muscle	Captive lamb, Corn Creek, Desert National Wildlife Range. Died of pneumonia.
3-71	M	9	85	11/25/71	Hock Kidney Lung	Hunter kill in Peek-A-Boo Canyon of Desert National Wildlife Range, Unit 27-B-3.
4-71	M	10	80	11/29/71	Hock Kidney Lung	Hunter kill on Lone Mt. in El Dorado Canyon.

Table 3. Vital Statistics of Desert Bighorn Sheep Sampled During 1970-1971 (continued)

Animal No.	Sex	Estimated Age(yr)	Estimated Wt (kg)	Date Collected	Samples Collected	Remarks
5-71	M	7	Unk	11/21/71	Lung	Hunter kill two-and one-half miles north of Horse Spring, Mormon Ridge.
6-71	M	7	80	11/27/71	Hock Kidney Lung	Hunter kill south end of Rag Mt. in Unit 27-B-1, Desert National Wildlife Range.
7-71	M	11	90	11/26/71	Hock Lung	Hunter kill two miles east of Quail Spring, Desert National Wildlife Range.
8-71	M	10	75	11/26/71	Hock Kidney Liver	Hunter kill, Unit 27-B-3, Desert National Wildlife Range.
9-71	M	11	90	12/05/71	Hock Kidney Lung	Hunter kill, Unit 27-B-2, Desert National Wildlife Range.
10-71	M	Unk	Unk	11/30/71	Hock Kidney Lung	Hunter kill in Muddy Mts.
11-71	M	Unk	Unk	Unk	Hock Kidney Lung	Hunter kill in Echo Wash of Unit 27-D-2.
12-71	M	8	65	12/11/71	Hock Kidney Lung	Hunter kill in Muddy Mts.
13-71	M	6	65	12/11/71	Hock Kidney Lung	Hunter kill, Dead Horse Trail, North Central portion of Sheep Range.
14-71	M	Unk	Unk	12/04/71	Hock Kidney Lung	Hunter kill in Highland Range.
15-71	M	Unk	Unk	06/71	Hock	Aged ram found dead in Chocolate Mts. in California.

ANALYTICAL PROCEDURES AND METHODS

Samples of soft tissue and rumen contents were quantitatively analyzed by gamma spectroscopy. Urine and/or blood were analyzed for tritium. Bone was analyzed for ^{89}Sr, ^{90}Sr, and ^{239}Pu. Selected soft tissues were also analyzed for ^{239}Pu content.

The soft tissues of sufficient volume and rumen contents were prepared for gamma analysis by grinding and placing in 1000-ml polyethylene Marinelli beakers. Those of smaller volume, i.e., thyroid, kidneys, etc., were prepared for analysis by macerating in a blender and were placed in an agar suspension in a 400-ml container. The samples were counted for 100 minutes on a 4-inch by 4-inch NaI(Tl) crystal connected to a 400-channel pulse-height analyzer calibrated at 10 keV/channel.

Tissues for ^{89}Sr, ^{90}Sr, and ^{239}Pu were prepared by low temperature ashing.

The plutonium was analyzed by alpha spectroscopy.[8,9] Other radionuclide analytical procedures used at the National Environmental Research Center-LV were described previously.[10]

All data are reported at the 95% confidence level and are corrected to time of collection. The minimum detectable activities for each radionuclide are listed in Appendix I and are expressed in the data tables of this report as less than a certain level of activity present in the total sample.

Tissue and lesion samples collected for histopathologic examination were first fixed in a 10% formalin solution. They were then dehydrated with alcohol, and embedded in paraffin prior to sectioning with a microtome. A five-micron section was placed on a glass slide and stained with hemotoxin and eosin. The slides were then delivered to a pathologist for interpretation (see Appendix II).

A 200- to 300-g sample of each mule deer's rumen contents was collected for botanical analysis. These samples were frozen until analyzed. Samples were prepared for botanical analysis by washing and screening a random aliquot,

which was then examined under a binocular microscope. Individual species of browse, forbs, and grasses were identified by procedures described elsewhere.[11] After the species in the sample were identified, a visual estimate was made of the fraction of each species in the sample (see Appendix III).

RESULTS AND DISCUSSION

CATTLE

The analytical results from tissues collected from Nevada Test Site beef animals during the spring of 1971 are presented in Table 4, the data from beef animals sampled during the fall are presented in Table 5, and data from the tissues of corralled dairy animals are presented in Table 6.

The rumen contents collected from the range animals showed the greatest variety of gamma-emitting radionuclides, with ^{95}Zr, ^{106}Ru, ^{144}Ce, and ^{137}Cs frequently present. Of these radionuclides, only ^{137}Cs and ^{106}Ru were found in the soft tissues with ^{106}Ru detected only in the lungs of animals sacrificed in May.

Iodine-131 was not detected in any cattle sampled during 1971. However, the short-lived radionuclides ^{103}Ru and ^{141}Ce were found in the rumen contents of a beef cow that died in June.

Rhodium-102 was reported in the liver, muscle, and kidney of a Holstein cow that died from gangrenous mastitis in August. This radionuclide has not previously been reported found in the tissues of Nevada Test Site cattle.

Elevated tritium levels (6.5 nCi/l of blood) were reported from two Hereford steers sacrificed in October. However, this may be explained in that both of these animals were utilized in an experiment designed to determine the biological half-life of tritium in lactating and nonlactating cattle. Fifty mCi of tritium was injected intravenously into each animal on March 8.

Plutonium-239 was detected in all rumen contents collected from the animals grazing in Area 18. This radionuclide was also present in most bone, lung, and liver samples, including those from the Area 15 corralled dairy cows. The levels in the Area 18 beef animals were expected, as they grazed in areas of known plutonium contamination. The levels found in the dairy cows indicate that either the Area 15 farm was contaminated from previous testing activities, i.e., Sedan, Baneberry, or the cows were exposed in the past, i.e., Cow No. AHU-11 was stanchioned three miles downwind from the Tatanquin Test in 1965.

Isotope	Bone Lumbar	Liver	Lung	Muscle	Thyroid	Kidney	Bone Femur	Blood	Tracheo-Bronchial Lymph Nodes	Fetal Muscle	Fetal Bone
^{6}	0.7(7)	1.3(7)	1.4(7)	1.5(7)		2.1(6)				2.7(2)	
pCi/kg	0.4-2.8	0.8-2.4	0.8-3.0	0.3-2.7	0.4	1.2-3.4	NA	NA	NA	2.6-2.8	NA
^{95}Zr pCi/kg	80(7) 30-200	25	25	25	25	25	NA	NA	NA	NA	NA
^{106}Ru pCi/kg	420(5) 370-460	250	1300(3) 1100-1500	250	250	250	NA	NA	NA	250	NA
^{131}I pCi/kg	25	25	25	25	25	25	NA	NA	NA	25	NA
^{137}Cs pCi/kg	25	90(3) 80-90	25	90(6) 80-120	25	25	NA	NA	NA	25	NA
^{144}Ce pCi/kg	410(4) 370-430	250	520(1)	250	250	250	NA	NA	NA	250	NA
^{141}Ce pCi/kg	250 1-NTS	125	125	125	125	125	NA	NA	NA	125	NA
^{103}Ru pCi/kg	160 1-NTS	25	25	25	25	25	NA	NA	NA	25	NA
^{3}H pCi/l	NA	NA	NA	NA	NA	NA	NA	1.2(6) 0.3-2.0	NA	NA +0.1-0.2	NA
^{239}Pu pCi/kg ash	NA	1.0(6) 0.4-2.4	14.6(7) 0.8-73.0	0.1	NA	NA	3.3(6) 0.3-7.0	NA	+0.8(3) ±0.1 ±0.4 10-300	1-NTS	0.1
^{239}Pu pCi/g ash	NA	0.04(6) 0.02-0.1	0.5(7) 0.01-1.8	0.01	NA	NA	0.005(5) 0.002-0.02	NA	+0.07±0.02 ±0.05±0.02 +15.0-2.0	+0.02±0.1 1-NTS	0.001
^{238}Pu pCi/kg	NA	0.3	14.6(2) 0.7-27.0	0.3	NA	NA	0.6	NA	1-NTS	0.3	0.3
^{238}Pu pCi/g ash	NA	0.02	0.18(2) 0.06-0.3	0.02	NA	NA	0.002	NA	+1.1±0.1 1-NTS	0.3	1.0
^{90}Sr pCi/kg	NA	NA	NA	NA	NA	NA	1200.0	NA	NA	NA	340.0
^{89}Sr pCi/g ash	NA	NA	NA	NA	NA	NA	5.0	NA	NA	NA	5.0
^{90}Sr pCi/kg	NA	NA	NA	NA	NA	NA	1460(7) 300-2600	NA	NA	NA	213(7) 200-230
^{90}Sr pCi/g ash	NA	NA	NA	NA	NA	NA	9.1(7) 2.0-17.0	NA	NA	NA	1.5(2) 1.0-2.0

Table 4. Summary of Analytical Results of Tissue Samples Collected from Seven Range Cattle the First Half of 1971 - Data Reported on Wet Weight Unless Otherwise Noted

Isotope	Whole Body Content	Liver	Lung	Muscle	Thyroid	Kidney	Bone Femur	Blood	Tracheo-Bronchial Lymph Nodes	Fetal Muscle
K	2.3(6)	2.6(6)	2.3(6)	3.1(6)		1.8(6)				
g/kg	1.8-2.7	1.7-3.2	1.2-3.1	2.8-3.1	NA	1.3-2.0	NA	NA	NA	1.2(1)
^{95}Zr	43(6)									
pCi/kg	30-60	25	25	25	25	25	NA	NA	NA	25
^{106}Ru	440(6)									
pCi/kg	270-630	250	250	250	250	250	NA	NA	NA	250
^{131}I										
pCi/g	25	25	25	25	25	25	NA	NA	NA	25
^{137}Cs	70(6)	40(6)	90(6)	40(6)						
pCi/kg	40-90	20-60	25-190	30-60	25	25	NA	NA	NA	25
^{144}Ce	390(6)									
pCi/kg	270-680	250	250	250	250	250	NA	NA	NA	250
^{3}H								6.5(2)		
pCi/l	NA	NA	NA	NA	NA	NA	NA	6.3-6.7	NA	NA
^{239}Pu	5.3(6)	0.37(4)	2.6(6)	≈0.2*0.1			1.3(3)		17(4)	
pCi/kg	2.9-9.1	0.3-0.5	0.9-7.7	9-NTS	NA	NA	0.5-3.0	NA	3.0-42.0	NA
^{238}Pu			≈0.6*0.3	≈1.9*0.5			≈2.1*0.7			
pCi/kg	0.6	0.3	12-NTS	10-NTS	NA	NA	14-NTS	NA	0.1	NA
^{239}Pu		0.04(4)	0.2(6)				0.008(3)			
pCi/g	0.2(6)	0.03-	0.0-	≈0.01*0.02			0.002-		0.9(4)	
ash	0.1-0.4	0.08	0.8	9-NTS	NA	NA	0.01	NA	0.2-2.5	NA
^{238}Pu			≈0.04*	≈0.2*			≈0.01*			
pCi/g			0.03	0.06			0.004			
ash	0.03	0.01	12-NTS	10-NTS	NA	NA	14-NTS	NA	0.1	NA
^{89}Sr							1500(2)			
pCi/kg	NA	NA	NA	NA	NA	NA	1300	NA	NA	NA
^{90}Sr							1700(6)			
pCi/kg	NA	NA	NA	NA	NA	NA	460-3700	NA	NA	NA
^{89}Sr										
pCi/g							7.3(2)			
ash	NA	NA	NA	NA	NA	NA	3-10	NA	NA	NA
^{90}Sr										
pCi/g							6.0(6)			
ash	NA	NA	NA	NA	NA	NA	3-19	NA	NA	NA

Table 5. Summary of Analytical Results of Tissue Samples Collected from Six Range Cattle During the Second Half of 1971 - Data Reported on Wet Weight Unless Otherwise Noted

Isotope	Muscle	Liver	Lungs	Muscle	Thyroid	Kidney	Bone Femur	Blood	Tracheo-Bronchial Lymph Nodes
^{89}Sr pCi/g	<1.8 AHE-11	1.4(3) 1.3-8.5	2.3(3) 1.1-3.9	2.8(3) 1.5-3.9	0.3	2.2 all Calf	NA	NA	NA
^{95}Zr pCi/g	<40 AHE-11	2-	2-	2-	2-	2-	NA	NA	NA
^{103}Ru pCi/g	<870 AHE-11	2-40	2-40	2-40	2-40	2-40	NA	NA	NA
^{131}I pCi/g	2-	2-	2-	2-	2-	2-	NA	NA	NA
^{137}Cs pCi/g	2-	2-	2-	2-	2-	2-	NA	NA	NA
^{140}La pCi/g	<300 AHE-11	2-40	2-40	2-40	2-40	2-40	NA	NA	NA
^{90}Sr pCi/g		<140 AHE-48		<80 AHE-48		<150 AHE-48	NA	NA	NA
^{3}H pCi/l	NA	NA	NA	NA	NA	NA	NA	2.1(2) 1.6-3.3	NA
^{239}Pu pCi/g	NA	1.6(3) 0.6-2.5	1.5(3) 0.2-3	0.1	NA	NA	0.7(3) 0.6-0.9	NA	<2.6*0.7 AHE-11
^{238}Pu pCi/g	NA	1.3	0.3	0.1	NA	NA	0.7	NA	0.1
^{239}Pu pCi/g	NA	0.06(3) 0.04-0.1	1.08(3) 0.02-3.2	0.009	NA	NA	0.003(3) 0.002- 0.003	NA	<0.17* 0.05 AHE-11
^{238}Pu pCi/g	NA	0.03	0.01	0.02	NA	NA	0.002	NA	0.05
^{89}Sr pCi/kg	NA	NA	NA	NA	NA	NA	1900	NA	NA
^{90}Sr pCi/kg	NA	NA	NA	NA	NA	NA	830(3) 740-930	NA	NA
^{89}Sr pCi/g ash	NA	NA	NA	NA	NA	NA	1.0	NA	NA
^{90}Sr pCi/g ash	NA	NA	NA	NA	NA	NA	1.3(3) 1-2	NA	NA

Table 6. Summary of Analytical Results of Tissue Samples Collected from Three Corralled Dairy Cattle - 1971

Detectable levels of ^{239}Pu were found in the muscle of a fetus from NTS No. 5 (an aged Hereford cow). This finding lends credibility to the postulated placental transfer of plutonium noted in animals sampled following the Baneberry Event.[17]

Plutonium-239 levels detected in the tracheo-bronchial lymph nodes from cattle sampled in May ranged from 0.07 pCi/g of ash (NTS-4) to 46 pCi/g of ash (NTS-5). This wide variance may be in part due to the small sample size which could be easily affected by the incorporation into the sample of small amounts of extraneous tissue, i.e., fat, that might contain a different concentration of the radionuclide.

The ^{90}Sr levels in femurs from the grazing animals averaged 7.7 pCi/g of ash which was somewhat elevated from the 1970 average[3] level of 4.1 pCi/g of ash (see Figure 2). The femurs of NTS 5 and 11, ages 14 and 12+, contained levels of 37 and 19 pCi/g of ash, respectively. If these two values are eliminated, the average was 4 pCi/g of ash.

Cows NTS 5 and 11 were part of the original NTS herd that was started in 1957 and have been exposed to test site activities for a greater number of years than any other cow sacrificed during 1971. At time of sacrifice, both animals were in good condition and were pregnant. Both reproduced normally each year during their lifetime. Significant gross or microscopic pathology was not observed. Radionuclide burdens in their tissues, with the exception of ^{90}Sr in both animals and ^{239}Pu in NTS-5, were of the same magnitude observed in the younger animals sampled.

Mule Deer

In general, the analytical results (Table 7) observed in tissues from mule deer were similar to those reported for the range cattle (Tables 4 - 5). However, certain tissues from mule deer 1 and 2 contained elevated levels of ^{106}Ru and ^{3}H, i.e., the rumen contents, muscle, and lungs from No. 1, contained 33 nCi/kg, 300 pCi/kg, and 600 pCi/kg, respectively, of ^{106}Ru and the same tissues collected from No. 2 contained 1400 pCi/kg, 500 pCi/kg, and 400 pCi/kg. The tritium levels in the blood from No. 1 was 41 nCi/l and from No. 2 it was 6500 pCi/l.

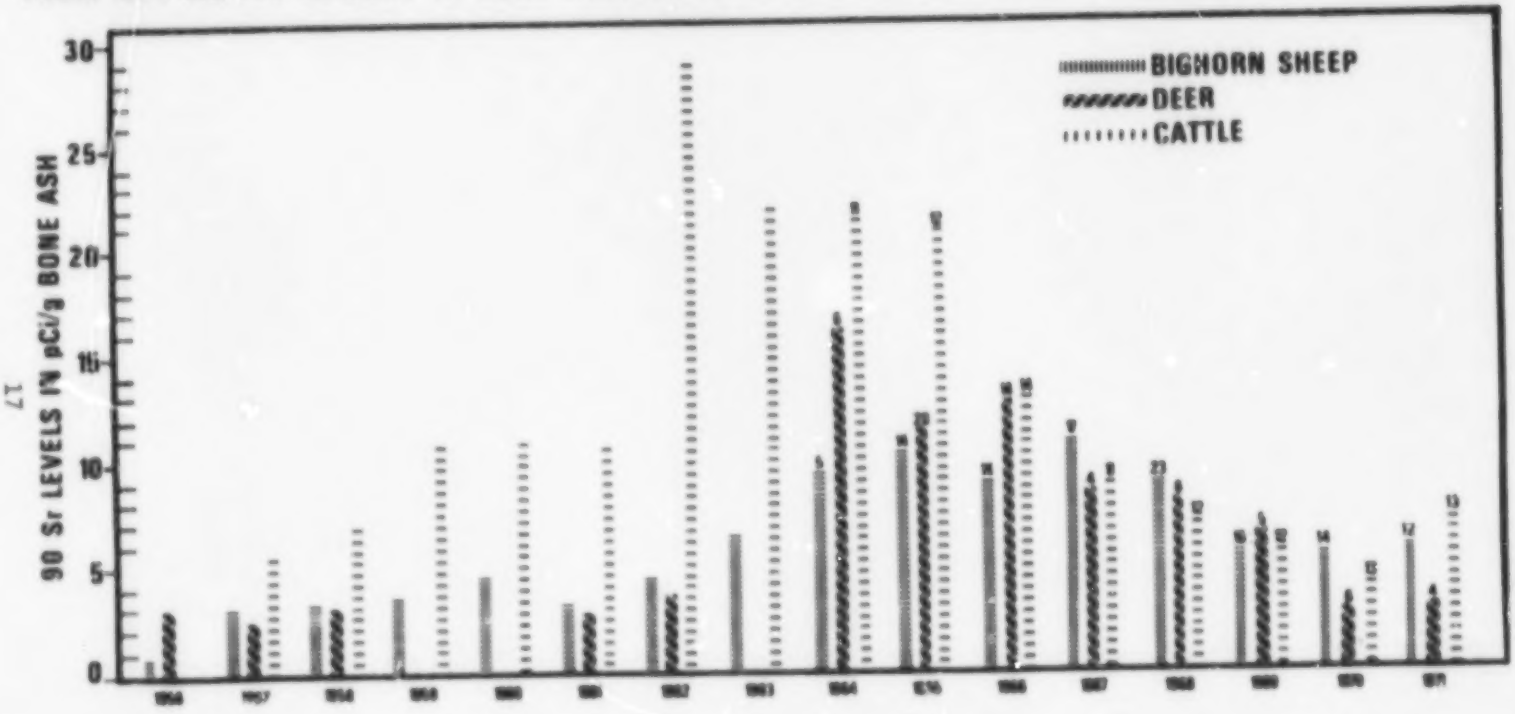

Figure 2. Comparison of ^{90}Sr in Bone of Bighorn Sheep, Deer, and Cattle.

These elevated levels apparently resulted from the animals drinking from ponds that collect the drainage waters from G tunnel in Area 12. A water sample collected from the ponds on December 13, 1970, contained 160 nCi/l and 150 μCi/l of ^{106}Ru and ^{3}H, respectively. Another water sample collected on March 17, 1971, contained 2.8 nCi/l of ^{106}Ru and 15 μCi/l of ^{3}H.

The results of the botanical analyses of the rumen contents of three of the deer are presented in Appendix III. These data reflect the preferred diet of deer for the vegetation available within their range at the season of collection. For example, it has been observed during the last two years that Purshia tridentata (bitterbrush) species and Artemisia tridentata (big sagebrush) were the predominant dietary components in the rumen contents of the deer collected from the mesa areas of the NTS during the late spring and summer and early fall while Cowania mexicana (Cliffrose var.) was preferred during the winter months.

Hypothetical Dose Estimates

Although meat from animals living on the Nevada Test Site is not available for consumption by the general public, the dose to a standard man based on postulated consumption of the meat, can be calculated. The dose estimates are not presented as an implication of potential doses, but rather to place the reported radionuclide concentrations in perspective. The dose estimates are based on the techniques and parameters of the International Commission on Radiological Protection (ICRP).[12,13] The maximum observed concentrations of the radionuclides in edible tissues of the cattle and deer sampled (summarized in Table 8), and the postulated consumption of 500 grams (about one pound) of the meat each day for a year. Table 9 indicates the doses resulting from these hypotheses. The doses are the total dose based on an intake of one year.

The ICRP[12] and the AEC[14] present different dose criteria for various parts of the body, based on estimates of relative radiosensitivity. The National Council on Radiation Protection and Measurement (NCRP)[15] recognizes this philosophy, but for the general population recommends simplifying the guides, and using the minimum guide (0.5 rem per year for the whole body) for all body organs. The NCRP emphasizes that this is a simplifying administrative decision, versus a reduction of the guides based on new technical information.

Isotope	Rumen Contents	Liver	Lung	Muscle	Thyroid	Kidney	Blood	Bone Rock
K g/kg	1.8(4) 0.7-2.3	3.1(4) 2.1-4.0	2.3(4) 1.9-2.7	2.9(4) 1.6-2.7	<0.4	3.2(4) 1.7-4.4	NA	NA
^{95}Zr pCi/kg	180(3) 50-300	<25	<25	<25	<25	<25	NA	NA
^{106}Ru pCi/kg	9000(4) 300-1300	<20	500(2) 400-600	400(2) 100-500	<250	<250	NA	NA
^{131}I pCi/kg	<25	<25	<25	<25	<25	<25	NA	NA
^{137}Cs pCi/kg	175(2) 50-300	35(2) 30-40	*60(1) #4 only	40(3) 30-50	<25	700(3) 600-900	NA	NA
^{144}Ce pCi/kg	950(3) 600-1400	*300(1) #3	*300(1) #2	<250	<250	<250	NA	NA
^{3}H nCi/l	NA	NA	NA	NA	NA	NA	12.4(6) 0.8-41.0	NA
^{239}Pu pCi/kg	5.1(2) 2.3-8.0	<0.1	0.9(3) 0.3-2.2	<0.1	NA	NA	NA	2.3(3) 1.2-4.1
^{239}Pu pCi/g ash	0.3(2) 0.1-0.5	<0.1	0.05(3) 0.03-0.11	<0.01	NA	NA	NA	0.007(3) 0.003-0.12
^{238}Pu pCi/kg	*1.2*6.0 #1	<0.3	0.3	0.3	NA	NA	NA	<0.8
^{238}Pu pCi/g ash	*0.07*0.03 #1	<0.02	<0.02	<0.02	NA	NA	NA	<0.003
^{89}Sr pCi/kg	NA	NA	NA	NA	NA	NA	NA	<600.0
^{89}Sr pCi/g ash	NA	NA	NA	NA	NA	NA	NA	3.0
^{90}Sr pCi/kg	NA	NA	NA	NA	NA	NA	NA	1000(4) 700-1500
^{90}Sr pCi/g ash	NA	NA	NA	NA	NA	NA	NA	3.2(4) 2.0-4.0

Table 7. Summary of Analytical Results of Tissue Samples Collected from Four Mule Deer - 1971
Data Reported on Wet Weight Unless Otherwise Noted

Table 8. Summary of Peak Radionuclide Concentration in Edible Tissues from NTS Cattle and Deer.

Nuclide	RANGE CATTLE						CORRALLED COWS		DEER		
	Early 71			Late 71							
	Liver	Muscle	Blood	Liver	Muscle	Blood	Liver	Blood	Liver	Muscle	Blood
^{106}Ru pCi/kg										500	
^{137}Cs pCi/kg	90	120		60	60				40	50	
^{144}Ce pCi/kg									300		
^{239}Pu pCi/kg	2.4			0.4	0.2±0.1		3.0				
^{238}Pu pCi/kg					1.9±0.5						
^{3}H nCi/l			2			6.7		3.5			41

The doses in Table 9 are for several different organs, and thus it is easiest to compare them to the single NCRP[15] guide of 0.5 rem/per year. The highest postulated dose (Table 9) is from ^{106}Ru in deer meat, less than 3% of the 0.5 rem yearly dose guide.

Desert Bighorn Sheep

Seven lung samples and six hock samples were collected from desert bighorn sheep killed during the 1970 hunt. The bone samples were analyzed for plutonium and strontium content and the lung samples for plutonium only.

Two lung samples contained detectable levels of ^{239}Pu. The range was 0.07-0.2 pCi/kg of ash (1.0-2.9 pCi/kg wet weight) and the average was 0.13 pCi/kg of ash (1.9 pCi/kg of wet weight).

Detectable levels of ^{239}Pu in the four positive bone samples ranged from 0.003-0.006 pCi/g ash (0.9 to 2.0 pCi/kg wet weight) and averaged 0.005 pCi/g of ash (1.3 pCi/kg wet weight). Detectable levels of ^{90}Sr in five of six bone samples ranged from 2.2-6.0 pCi/g of ash (600-21,000 pCi/kg wet weight) and averaged 4.7 pCi/g of ash (1200 pCi/kg wet weight). The average level of ^{90}Sr in the hocks collected during the 1969 hunt was 5.6 pCi/g of ash.[3,15]

The fifteen desert bighorn sheep sampled during 1971 provided fourteen hock bone samples, ten kidney samples, twelve lung samples and one muscle sample. The kidneys and muscle were analyzed for tritium, the lungs for plutonium, and the hock bones for plutonium and strontium.

Nine tritium values were reported from the tissues analyzed. The range was 500-700 pCi/l of body water and averaged 600 pCi/l.

Detectable levels of ^{239}Pu were found in six lung samples. The range was 0.02-0.12 pCi/g of ash (0.5-2.7 of pCi/kg wet weight) and averaged 0.06 pCi/g of ash (1.2 pCi/kg wet weight).

Table 9. Postulated Dose to Man Following Ingestion of Selected Tissues for One Year

Nuclide	Human Organ for which Dose is Calculated	Animal Tissue Containing Maximum Concentration	pCi/kg	rem/pCi Ingested	rem	Percent of 0.5 rem[a]
^{106}Ru	Lower large intestine gastrointestine tract	Deer, muscle	500	1.4×10^{-7}	0.013	2.6
^{144}Ce	Lower large intestine gastrointestine tract	Deer, liver	300	1.8×10^{-7}	0.010	2.0
^{137}Cs	Whole body	Range cattle, muscle	120	6.1×10^{-8}	0.0013	0.27
^{3}H	Body water	Deer, blood[b]	41,000	9.8×10^{-11}	0.00073	0.15
^{239}Pu	Bone	Corralled cows, liver	3	8.54×10^{-7}	0.00047	0.094
^{238}Pu	Bone	Range cattle, muscle	1.9	7.49×10^{-7}	0.00026	0.052

[a]The doses from ^{238}Pu, ^{239}Pu, and to a smaller extent ^{137}Cs should not be delivered within the one-year ingestion time. But for simplification, the one-year guide has been used.

[b]Assumed concentration in edible tissue would be similar.

Twelve ^{90}Sr values were reported from the hock samples. The range was 1.0-12.0 pCi/g of ash (700-5000 pCi/kg wet weight) and averaged 5.8 pCi/g of ash (1800 pCi/kg). Two ^{89}Sr values were reported. The hock sample fo No. 7-71 contained 4.0±2.0 pCi/g of ash (1200±600 pCi/kg wet weight) and that from No. 11-71 was 5.9±3.8 pCi/g ash (1900±1300 pCi/g wet weight). Four hock samples (Nos. 6, 7, 8, and 13) contained detectable levels of ^{239}Pu which ranged from 0.003-0.007 pCi/g of ash (0.7-1.9 pCi/kg wet weight) and averaged 0.004 pCi/g of ash (0.9 pCi/kg wet weight). Plutonium-238 was not reported in any of the hock samples.

Feral Horses

On January 14, 1971, skeletal remains of an aged horse were found at Captain Jack Springs of Area 12. Analysis of the bone from this horse revealed ^{90}Sr contents of 4.0±0.9 pCi/g of ash (720±170 pCi/kg wet weight), ^{238}Pu levels of 0.006±0.003 pCi/g of ash (4.0±2.0 pCi/kg wet weight) and ^{239}Pu levels of 0.018±0.004 pCi/g of ash (10.0±2.0 pCi/kg wet weight). Detectable levels of ^{89}Sr were not reported.

On October 16, 1971, the body of an aged female horse in advanced stages of decomposition was found on Holmes Road in Area 12. Bone and muscle samples were collected. The only gamma-emitting radionuclide detected in the muscle was ^{137}Cs (80 pCi/kg). The tritium content of the body water was 15.0±0.6 nCi/l. Strontium-89 levels in the bone were 6.0±5.0 pCi/g of ash (1400±1200 pCi/kg).

Strontium-90 levels were 11.0±2.0 pCi/g of ash (2400±400 pCi/kg wet weight) and ^{239}Pu levels were 0.006±0.002 pCi/g of ash (1.4±0.5 pCi/kg wet weight). Detectable levels of ^{238}Pu were not reported.

Golden Eagles

On 1 August 1971, the decomposed body of a Golden eagle was found beneath a power line in Area 6. The apparent cause of death was electrocution. The advanced decomposition of the carcass prevented the sampling of any tissues other than bone. The analysis revealed 0.013±0.003 pCi/g of ash (2.1±0.5 pCi/kg wet weight) of ^{239}Pu, <0.003 pCi/g of ash of ^{238}Pu, and <2.0 pCi/g of ash for ^{89}Sr and ^{90}Sr.

Table 10. Comparison of Radioanalysis of Tissues from Eagles Killed in 1964 and 1971

*	^{89}Sr pCi/g ash pCi/kg	^{90}Sr pCi/g ash pCi/kg	^{238}Pu pCi/g ash pCi/kg	^{239}Pu pCi/g ash pCi/kg	^{3}H pCi/kg	^{137}Cs pCi/kg
Bone 1964	<5	0.8±0.7	<0.003	0.004±0.002		
Eagle	<500	90±70	<0.1	0.4±0.2	NA	NA
Bone 1971	<2	<0.6	0.003±0.003	0.015±0.003		
Eagle	<200	<700	0.4±0.3	1.7±0.3	NA	NA
Muscle 1964			<0.02	0.03±0.02	1000	
Eagle	NA	NA	<0.3	0.3±0.2	300	<300
Muscle 1971			<0.03	0.02±0.02		
Eagle	NA	NA	<0.4	0.2±0.2	<300	<200
Liver 1964						
Eagle	NA	NA	NA	NA	NA	3500
Liver 1971						
Eagle	NA	NA	NA	NA	NA	4100
Lung 1964						
Eagle	NA	NA	NA	NA	NA	1800
Lung 1971						
Eagle	NA	NA	NA	NA	NA	1900
Stomach Contents 1964						
Eagle	NA	NA	NA	NA	NA	3300
Stomach Contents 1971						
Eagle	NA	NA	NA	NA	NA	1700
Intestines and Contents 1964 Eagle	NA	NA	NA	NA	NA	700
Intestines and Contents 1971 Eagle	NA	NA	NA	NA	NA	2300

NA = Not analyzed.

* Each radionuclide detected in a tissue was reported in pCi/g ash (Top Value) and in pCi/kg of wet tissue (Bottom Value).

On July 1, 1971, a Golden eagle was killed by a motor vehicle in Area 27. The carcass of another Golden eagle was found in a freezer at the Corn Creek station of the Desert National Wildlife Range. Little is known about this eagle except that it was killed on the Desert National Wildlife Range early in 1964. Table 10 presents the data of these two birds. It is interesting to note that the reported ^{137}Cs values are the same magnitude despite the seven-year interval between the deaths of these two eagles. Cesium-137 was the only gamma-emitting radionuclide detected in the soft tissues.

Coyotes

Another Nevada Test Site predator that is occasionally sampled is the coyote. During 1971 two coyotes were collected, coyote No. 1 was an immature male collected one-half mile west of CP 30 on July 27, and coyote No. 2 was a mature female collected near the Area 18 air strip on October 6.

Cesium-137 was the only gamma-emitting radionuclide detected in the soft tissues of these animals. The analytical results of the coyote tissues are presented in Table 10.

The pathologist that examined tissue sections from coyote No. 1 reported a small pulmonary granuloma that resulted from a reaction to a foreign pigmented material that was seen throughout the lungs. Similar granulomas were found in the lungs of the second coyote which were examined by a different pathologist (see Appendix II). Testicular Hypoplasia was detected in tissues from coyote No. 1. This is probably due to the immaturity of the animal.

Chukar

One chukar was sampled during 1971. It was collected near Well 8 in Area 18 on November 10, 1971. Gamma-emitting radionuclides were not detected in the tissue. The tritium level found was 700 ± 300 pCi/l of body water. The ^{90}Sr content of the bones was 3.0 ± 1.0 pCi/g of ash (160 ± 70 pCi/kg), and the ^{239}Pu content was 0.05 ± 0.01 pCi/g of ash (3.0 ± 0.8 pCi/kg).

Table 11. Summary of Analytical Data From Tissues Collected From NTS Coyotes - 1971

*	^{89}Sr pCi/g ash pCi/kg	^{90}Sr pCi/g ash pCi/kg	^{238}Pu pCi/g ash pCi/kg	^{239}Pu pCi/g ash pCi/kg	^{3}H pCi/l	^{137}Cs pCi/kg
Bone	<3	8±1.1	<0.004	0.006±0.003		
Coyote #1	<600	1600±300	<0.9	1.3±0.6	NA	NA
Bone	<3	7±1	0.016±0.005	0.016±0.004		
Coyote #2	<700	1500±300	4.0±1.0	3.6±0.9	NA	NA
Lung			0.14±0.04	1.2±0.09		
Coyote #1	NA	NA	3.0±0.8	22.0±2.0	NA	500
Lung			0.08±0.04	1.5±0.1		
Coyote #2	NA	NA	3.0±1.0	35.0±4.0	NA	<25
Liver			<0.03	0.3±0.06		
Coyote #2	NA	NA	<0.1	10.0±2.0	NA	200
Muscle						
Coyote #1	NA	NA	NA	NA	NA	300
Muscle			<0.04	<0.01		
Coyote #2	NA	NA	<0.1	<0.3	NA	100
Blood						
Coyote #1	NA	NA	NA	NA	1200±300	NA
Blood						
Coyote #2	NA	NA	NA	NA	800±300	NA

NA = Not analyzed.

* Each radionuclide detected in a tissue was recorded in pCi/g of ash (Top Value) and in pCi/kg of wet tissue (Bottom Value).

SPECIAL STUDIES AND INVESTIGATIONS

Baneberry Studies

The Baneberry Event, which was detonated on December 18, 1970, in Area 8 of the Nevada Test Site, resulted in the accidental release of significant amounts of radioactivity from the site. The Animal Investigation Program initiated studies to document the distribution of the released radionuclides within the tissues of domestic and wild animals that resided within the fallout pattern on and surrounding the Nevada Test Site. A grazing study, which utilized rumen-fistulated steers, was also conducted. The analytical data collected from these studies will be published as a separate report.(17) An investigation of injury and death in grazing sheep allegedly resulting from the Baneberry Event was reported previously.(18) Also investigated was alleged radiation sickness in domestic animals residing on a farmstead near Ursine, Nevada.(17) Data collected during these investigations indicated that the illnesses were not related to the Baneberry Event.

Environmental Plutonium Levels in Bovine Tissues

In January of 1971, through the cooperation of the University of Nevada, Reno, tissue samples were collected from six mature Hereford range cattle that grazed in the Reno area. These samples were analyzed for plutonium and strontium content. The data will serve as a baseline for comparison studies with those levels found in cattle grazing areas of known contamination on or near the Nevada Test Site. The analytical results are presented in Table 12. Comparison of these data with that reported from the NTS beef cattle (Tables 4 and 5) reveals that the ^{90}Sr femur levels are similar and indicates that the source in both cases was world-wide fallout. The ^{239}Pu bone levels are higher in the NTS cattle, which indicates a local source for this radionuclide. Indeed, areas of the Area 18 range contain plutonium debris deposited during the atmospheric detonations conducted there during the early 1960's.(6)

OTHER ACTIVITIES

During 1971, the objectives and findings of the Animal Investigation Program were described to approximately 450 Nevada Test Site visitors. These visitors

Animal No.	Lung		T-B Lymph Nodes*		Liver		Milk				
	^{238}Pu fCi/g ash fCi/kg**	^{239}Pu fCi/g ash fCi/kg	^{238}Pu fCi/g ash fCi/kg	^{239}Pu fCi/g ash fCi/kg	^{238}Pu fCi/g ash fCi/kg	^{239}Pu fCi/g ash fCi/kg	^{90}Sr pCi/g ash pCi/kg	^{90}Sr pCi/g ash pCi/kg	^{238}Pu fCi/g ash fCi/kg	^{239}Pu fCi/g ash fCi/kg	Remarks
1	1.3 9.9	1 ± 1.5 20 ± 30	1 200	60 6000	1.1 70	1.4 ± 1.1 16 ± 10	1.1 290	2.7 ± 0.81 700 ± 210	0.21 53	0.17 41	Two-pie Butte Feed Line
2	2 20	1 ± 1 10 ± 10	110 7200	31 2000	3.2 80	1.1 ± 1.2 40 ± 80	1.2 ± 1.1 480 ± 440	1.1 ± 0.78 440 ± 280	0.21 90	0.13 ± 0.17 68 ± 61	Four-Leaf Cl Unfenced Fee
3	4.5 90	4.5 ± 2.1 90 ± 80	68 5000	41 3000	1.1 60	1.6 ± 1.1 90 ± 60	2.1 820	11 ± 1.1 4300 ± 390	0.28 100	0.21 ± 0.76 800 ± 400	Two-Leaf Cl Unfenced Fee
4	4 ± 2 60 ± 30	4 ± 2 60 ± 30	61 3500	21 890	6.2 81	9.2 ± 4.6 120 ± 60	2.1 810	14 ± 1.8 5400 ± 610	0.29 99	0.1 ± 0.21 170 ± 70	Mahoke Butte Feed Line
5	4.4 60	3.3 ± 3.3 30 ± 30	130 9300	6.7 ± 16 4000 ± 4000	3.4 30	4.2 ± 3.5 80 ± 30	2.1 710	9.4 ± 1.5 3200 ± 510	0.26 88	0.62 ± 0.24 230 ± 80	Mahoke Butte Feed Line
6	2.9 20	4.3 ± 1.4 30 ± 10	110 7400	36 2000	2.9 20	4.6 ± 2.9 60 ± 20	1.8 630	7.8 ± 1.3 2800 ± 470	0.28 100	0.83 ± 0.28 300 ± 100	Four-Leaf Cl Unfenced Fee
MEDIAN	3.95 30	3.61 35	89 6100	28.5 2400	3.3 30	6.2 70	1.9 660	8.6 2400	0.265 95	0.34 190	
RANGE	1.3- 4.5 1.9-30	1-4.5 10-30	4-130 210-9200	2?-41 890-6000	2.9- 6.2 20-81	1.1-9.2 10-120	1.1-2.1 290-820	1.1-14.0 440-4800	0.25- 0.29 71-100	0.12-0.83 41-300	

Table 12. Summary of Plutonium and Strontium Data from Tissue Samples Collected from Northern Nevada Cattle

included reporters, students, teachers, industrialists, civic groups, state officials and foreign officials.

Information on the National Environmental Research Center, Las Vegas, the U. S. Atomic Energy Commission and the Animal Investigation Program was disseminated to over 60,000 visitors to an exhibit featuring a fistulated steer which was displayed at the White Pine and Clark County, Nevada Fairs and the New Mexico State Fair.

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APPENDIX I. Minimum Detectable Activities For Radionuclide Analyses Technical Support Laboratory, National Environmental Research Center-Las Vegas, Nevada

The minimum detectable activities (MDA's) in terms of total activity per sample for standard geometries and counting times are based on a combination of a number of technical experiments and operational experience. By means of experimentation the MDA has been defined as that activity which produced a ±100% deviation at the 95% confidence level. These values are applicable to ideal conditions and simple complexes of nuclides. Complex spectra or spectra showing naturally occurring radionuclides can raise the MDA's considerably.

Minimum Detectable Activities in pCi for Total Sample

	10-Min Count	40-Min Count			100-Min Count		
Isotope	Planchet	Planchet	400 ml	3.5 liter	400 ml	1000 ml	3.5 liter
^{54}Mn	50	25	40	35	25	25	22
^{65}Zn	500	250	400	350	250	250	220
^{60}Co	50	25	40	35	25	25	22
^{95}Zr	50	25	40	35	25	25	22
^{103}Ru	50	25	40	35	25	25	22
^{106}Ru	500	250	400	350	250	250	220
^{124}Sb	50	25	40	35	25	25	22
^{125}Sb	250	125	200	175	125	125	110
^{132}Te	50	25	40	35	25	25	22
^{131}I	50	25	40	35	25	25	22
^{133}I	50	25	40	35	25	25	22
^{137}Cs	50	25	40	35	25	25	22
^{140}Ba	50	25	40	35	25	25	22
^{141}Ce	250	125	200	175	125	125	110
^{144}Ce	500	250	400	350	250	250	220
^{181}W	600	300	475	425	300	300	260

APPENDIX I. Minimum Detectable Activities For Radionuclide Analyses (continued)

Isotope	10-Min Count	40-Min Count			100-Min Count		
	Planchet	Planchet	400 ml	3.5 liter	400 ml	1000 ml	3.5 liter
^{3}H		0.4 pCi per ml of H_2O					
^{89}Sr		5.0 pCi total sample of ash					
^{90}Sr		2.0 pCi total sample of ash					
^{238}Pu		0.01 pCi per gram of ash					
^{239}Pu		0.01 pCi per gram of ash					
K*	0.5	0.3	0.4	0.4	0.3	0.3	0.25

*g/kg

APPENDIX II. Gross* and Microscopic Pathology** Found in Necropsied Animals

Cattle

AHU-11

Necropsy findings - Severe arthritis of right stifle joint with exostosis and erosion of the patella and lateral condyle of the femur. Slight arthritis of left stifle joint.

Histopathologic findings - Improper fixation of tissues made interpretation impossible.

Clinical diagnosis - Arthritis

2-NTS through 6-NTS

Necropsy findings - No gross lesions observed in any of the animals.

Histopathologic findings - Improper fixation of tissues but no abnormalities noted.

Clinical diagnosis - Normal

7-NTS

Necropsy findings - Squamous cell carcinoma of right eye with extensive necrosis of periorbital tissue. Actinbacillosis of right jaw with pustular tracts extending down the muscles of the neck. Digestive system flacid and empty. Extremely cachexic.

Histopathologic findings - Not sampled as advanced post mortem changes prior to necropsy.

Clinical diagnosis - Death from starvation. Inability to graze.

8-NTS

Necropsy findings - Emaciated, but no abnormal conditions noted.

Histopathologic findings - Not sampled.

Clinical diagnosis - Normal

AHU-132

Necropsy findings - Rumen greatly distended with tympanites. Adhesions between reticulum and liver. Liver contained large abscess around a piece of baling wire.

Histopathologic findings - Not sampled as advanced post mortem changes.

Clinical diagnosis - Death from tympanites as a complication of traumatic gastritis.

AHU-48

Necropsy findings - Not necropsied as prosector not available.

Histopathologic findings - Not sampled as advanced post mortem changes.

APPENDIX II. Gross* and Microscopic Pathology** Found in Necropsied Animals (continued)

Clinical diagnosis - Gangrenous mastitis.

9 & 10-NTS

Necropsy findings - No gross lesions observed.

Histopathologic findings - All tissues within normal limits.

Clinical diagnosis - Normal.

11-NTS

Necropsy findings - No gross lesions observed.

Histopathologic findings - Arteriosclerotic changes observed in blood vessels of spleen and kidney. Slight emphysema of lungs. Rest of tissues within normal limits.

Clinical diagnosis - Normal

12-NTS

Necropsy findings - No gross lesions observed.

Histopathologic findings - Appearance of thyroid cells suggests some hyperplasia but changes are not marked. Rest of tissues within normal limits.

Clinical diagnosis - Normal.

13 & 14-NTS

Necropsy findings - No gross lesions noted.

Histopathologic findings - All tissues within normal limits.

Clinical diagnosis - Normal.

Mule Deer

No. 1

Necropsy findings - No gross lesions noted.

Histopathologic findings - All tissues within normal limits.

Clinical diagnosis - Normal.

No. 2

Necropsy findings - Multiple fractures of rear legs. Liver was fragmented. Massive internal hemorrhage. Rupture of rumen.

Histopathologic findings - Not sampled as advanced post mortem changes.

Clinical diagnosis - Death resulted from extensive trauma as result of collision with motor vehicle.

APPENDIX II. Gross* and Microscopic Pathology** Found in Necropsied Animals (continued)

No. 3

Necropsy findings - Miltiple fractures of rear legs. Liver was fragmented. Massive internal hemorrhage. Rupture of rumen. Peritoneal cavity was ruptured with protrusion of abdominal viscera.

Histopathologic findings - Not sampled as advanced post mortem changes.

Clinical diagnosis - Death resulted from extensive trauma as result of collision with motor vehicle.

No. 4

Necropsy findings - No gross lesions noted.

Histopathologic findings - Sarcosporidia are found within several muscle fibers.

Clinical diagnosis - Normal.

Desert Bighorn Sheep

Hunter killed desert bighorn sheep not necropsied or sampled for histopathologic examination.

1-71

Necropsy findings - Adhesions of lung to pleura. Many small abscesses in diaphragmatic lobes of lungs.

Histopathologic findings - Abomasum - focal necrosis of epithelial cells. Lungs - atelectasis, pleuritis with adhesions to diaphragm marked bronchopneumonia, bacteria colonies in airways, fibrinous exudate in septae, and cellular thrombus in the blood vessels.

Clinical diagnosis - 1) pneumonia and pleuritis, probably pasteurellosis, 2) fecal necrotizing abomasitis.

2-71

Necropsy findings - Extensive adhesions between lungs and pleura. Areas of abscessation and atelectasis in diaphragmatic lobes of lungs. Estimated less than 20% normal lung tissue present.

Histopathologic findings - Lung - atelectasis, bacterial pleuritis and bronchopneumonia with many colonies of bacteria present especially in the airways. Adhesions to paretial pleura with necrosis and fibrosis.

Clinical diagnosis - Pneumonia and pleuritis, probably pasteurellosis.

Coyotes

No. 1

Necropsy findings - No gross lesions noted.

APPENDIX II. Gross* and Microscopic Pathology** Found in Necropsied Animals (concluded)

Histopathologic findings - Kidney - a few foci of interstitial inflammation. Lungs - Many small foci of brown pigment throughout lungs, especially at muscle tips of terminal bronchioles. A large subplural granuloma containing concentric laminae of collagen. In the center of this lesion is foreign material. Testes - seminiferous tubules contain sertali cells only. No sperm are seen.

Diagnosis - 1) Testicular hypoplasia, 2) Pulmonary granuloma - Reaction to foreign material.

No. 2 Necropsy findings - No gross lesions noted.

Histopathologic findings - Lungs - The lungs show numerous small granuloma like areas. These are composed of macrophages filled with granular olive brown pigment resembling hemosiderin. There is also some lymphocytic infiltration in these structures. Some of them consists only of a few cells and appear to occupy the alveolar septums. Others are larger replacing several of the alveoli. Some of these structures are seen adjacent to the small bronchi. The large bronchi and vessels show nothing of note. Aside from the granuloma like areas the lung structure is normal. All other tissues within normal limits.

Diagnosis - Pulmonary granuloma similar to that reported in No. 1.

* As reported by the senior author.

** As reported by Dr. Jerrold M. Ward, Division of Biological Effects, Bureau of Radiological Health, 12720 Twinbrook Parkway, Rockville, Maryland 20852 or by Dr. James Y. Clarke, 540 East Sahara, Las Vegas, Nevada 89105.

APPENDIX III. Botanical Analysis of Rumen Contents from Nevada Test Site Mule Deer

Animal No.	Date Collected	Scientific Name	Common Name	Plant Parts	Composition
1	04/06/71	*Purshia glandulosa*	Desert Bitterbrush	Stems, leaves	51%
		Eriogonum spp. (woody)	Buckwheat	Stems, leaves	19%
		Artemisia tridentata	Big Sagebrush	Stems, leaves	10%
		Phoradendron spp.	Mistletoe	Stems	7%
		Quercus gambeli	Gambel Oak	Leaf fragments	5%
		Grass species		Leaves	4%
		Unidentified shrub		Leaves	3%
		Eriogonum spp. (herbaceous)	Buckwheat	Stems	1%
2	07/13/71	*Purshia glandulosa*	Desert Bitterbrush	Stems, leaves	55%
		Quercus gambeli	Gamble Oak	Leaves, stems	17%
		Eriogonum spp. (woody)	Buckwheat	Leaves, stems	11%
		Grass species		Leaves	6%
		Unidentified shrub		Leaves	5%
		Cowania stansburiana	Cliff Rose	Leaves, stems	4%
		Eriogonum spp. (herbaceous)	Buckwheat	Flowers, stems	2%
4	11/10/71	*Cowania stansburiana*	Cliff Rose	Stems, leaves	100%
		Phoradendron spp.	Mistletoe	Stems	Trace
		Grass species		Stems, leaves	Trace
		Unidentified shrub		Fragments	Trace